REMARKS

Present Status of the Application

The Office Action mailed March 26, 2001, rejected all claims 1-5. Specifically, the Office Action rejected claims 1 and 5 under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification. The Office Action also rejected claims 1-5 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter. In addition, The Office Action rejected claims 2-4 under 35. U.S.C. 102(b) as being anticipated by Yu (U.S. Pat. No. 5,553663), and rejected claim 5 under 35. U.S.C. 102(b) as being anticipated by Aoyagi (U.S. Pat. No. 4,907,646). The Offica Action also objected to the drawings.

Applicants have amended claims 2-5 above to more clearly define the invention. Applicants have also amended claim 1 to correct a typing error. Applicants respectfully submit that no new matter is added by way of these amendments. New Fig. 5 is added and the specification is amended accordingly. No new matter is introduced through the amendment. After entry of the foregoing amendments, claims 1-5 remain pending in the present application, and reconsideration of those claims is respectfully requested.

Summary of Applicants' Invention

Applicants' invention is directed to a heat exchanger in which high heat transfer efficiency has been attained by optimizing the slit array and setting an optimum range for the width of a slit and the spacing between slits. Slits 51 and 52 formed in front of the heat transfer coil 4 and slits 55 and 56 formed behind said heat transfer coil are arranged so as to provide a mutually different length among adjoining partitioned slits in the vertical direction, as well as a

mutually different length between directly opposite partitioned slits in the horizontal direction. As a result, the position at which the slit is partitioned is staggered. The two slits 53 and 54 formed side by side between heat transfer coil 4 and heat transfer coil 4 are of the same length. For a 7 mm diameter heat transfer coil, the slit width relative to the diameter of the heat transfer coil ranges from 1.2/7 (approximately 0.17) to 2.0/7 (approximately 0.29), and the slit spacing relative to the diameter of the heat transfer coil ranges from 1.3/7 (approximately 0.18) to 3.5/7 (approximately 0.5).

Discussion of Office Action Rejections

Objection to Drawings:

The Office Action objected to the drawings of Figs. 3, 4A and 4B because they are not labeled by "Prior Art". The Office Action further objected to the drawings because variables such as Ws, Wr and N are not labeled. In response, Applicants have amended Figs. 3, 4A and 4B to label "Prior Art". In addition, the variables Ws and W_F are clearly labeled in Fig. 1. In regard to the variable N, it is defined as N = the number of slit arrays / number of heat transfer fin units. In Fig. 1, only one fin unit is drawn, and it is a little difficult to express the variable N in the drawing. However, Applicants respectfully submit that those skilled in this art can understand from the specification and claim description.

In view of above, withdrawal of the objection to the drawings is requested. Formal drawings will be submitted when this application is allowed.

Claim Rejections – 35 U.S.C. 112:

The Office Action rejected claim 1 under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification. In regard to claim 1, it describes that the configuration of the heat exchanger satisfies the correlation expressed by the numerical formula: Ws ≥ (1-0.1 (6-N)) x WF/(2N+1), wherein, *Ws = width of each slit formed on said heat transfer fins, W_F = width of a heat transfer fin, and N = the number of slit arrays formed on said heat transfer fin / number of heat transfer fin units.* Applicants noticed that there is a typing error in claim 1, i.e., in the "≥" sign in the above formula was missed. Applicants have amended claim 1 to add the missing "≥" sign. Applicants believe that this amendment is supported by the original filed application documents (See the Certified copy of priority documents (JP application number 2000-053617) filed together with the present application). The dimensions disclosed in the specification also support the above formula. Applicants respectfully submit that those skilled in the art can easily understand how to implement the configuration of the heat exchanger of the claimed invention according to the above formula.

Withdrawal of the rejection to claim 1 under 35 U.S.C. 112, first paragraph, is requested.

The Office Action further rejected claim 5 under 35 U.S.C. 112, first paragraph, as containing subject matter, which was not described in the specification. The Office Action stated that "for a given slit array the slit formed on either edge of a heat transfer fin is partitioned into slits of different length" is not supported in the drawings. On page 5, last paragraph, of the original specification, it describes that "*there is a mutually different length among adjoining partitioned slits in the vertical direction, as well as a mutually different length between directly opposite partitioned slits in the horizontal direction. As a result, the position at which the slits*

are partitioned is staggered". Namely, slits 51, 52 and slits 55, 56 are partitioned from one slit at positions 5, and 6 respectively. Thus, claim 5 is fully supported by the specification. However, Fig. 1 only shows the result. In order to clearly show the above structures described in the specification, Applicants have added a new drawing Fig. 5, which is fully supported by the specification (on page 5, lines 20-23). Newly added drawing Fig. 5 only uses dash lines 5, 6 to represent the slit status before the slit is partitioned, otherwise, it is identical with Fig. 1. Specification is also amended accordingly. Applicants respectfully submit that no new matter is added in the amendments of the specification and drawings.

Withdrawal of the rejection to claim 1 under 35 U.S.C. 112, first paragraph, is requested.

The Office Action rejected claims 1-5 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter. The Office Action stated that variables Ws, W_F, and N in claim 1 are not labeled in the drawing. In response, for the reasons set out above, Applicants respectfully submit that this rejection is overcome.

In regard to claim 5, the Office Action stated that "the position at which the slit is partitioned is staggered on each of the two edges of the heat transfer fin" is not understood". In response, the term "stagger" means that the partition positions 5, 6, for example for the slits (51, 52) and (55, 56) are interleaved, and not at the same level. Applicants wishes this interpretation can make the Office Action understood. As for the rejection due to the insufficient antecedent basis in claims 2-5, Applicants have amended claims 2-5 to correct those error, and the rejection should be withdrawn.

Claim Rejections – 35 U.S.C. 102:

Turning now to the substantive rejection, the Office Action rejected claims 2-4 under 35 U.S.C. 102(b), as being anticipated by Yu. In addition, the Office Action rejected claim 5 under 35 U.S.C. 102(b), as being anticipated by Aoyagi. In response, Applicants respectfully traverse these rejections for at least reasons set forth as followings.

Applicants' invention is directed to a heat exchanger. As shown in Fig. 1, for example, slits 51 and 52 formed in front of the heat transfer coil 4 and slits 55 and 56 formed behind the heat transfer coil are arranged so as to provide a mutually different length among adjoining partitioned slits in the vertical direction, as well as a mutually different length between directly opposite partitioned slits in the horizontal direction. As a result, the position at which the slit is partitioned is staggered. The two slits 53 and 54 formed side by side between heat transfer coils 4 are of the same length. The requisite features of independent claims 1-5 in the invention are recited immediately as follows:

> 1. (Once Amended) A heat exchanger in which heat transfer coils penetrate through a row of multiple plate-shaped heat transfer fins set at a specified fin pitch and in which air is supplied orthogonally to said heat transfer coils, characterized by a configuration so as to satisfy the correlation expressed by the following numerical formula:
> $Ws \geq (1\text{-}0.1\ (6\text{-}N)) \times W_F/(2N+1)$
> where, Ws = width of each slit formed on said heat transfer fins, W_F = width of a heat transfer fin, and N = the number of slit arrays formed on said heat transfer fin / number of heat transfer fin units.

(*Emphasis added*) Also, independent claim 2 recites:

> 2. (Once Amended) A heat exchanger in which heat transfer coils penetrate through a row of multiple plate-shaped heat transfer fins set at a specified fin pitch, and slits are formed on each plate-shaped heat transfer fin, and in which air is supplied orthogonally to said heat transfer coils, characterized by a configuration in which ***a width of each slit formed orthogonal to the air flow on each heat transfer fin is set within a range of 0.17 - 0.29 times a diameter of the heat transfer coils***, wherein two slits formed in front of the heat transfer coil and two slits formed behind said heat

transfer coil ***are arranged so there is a mutually different length in a direction perpendicular to the air flow***, and wherein a ***cut profile between the two slits in different lengths is parallel to the air flow.***

(*Emphasis added*) Also, independent claim 3 recites:

> 3. (Once Amended) A heat exchanger in which heat transfer coils penetrate through a row of multiple plate-shaped heat transfer fins set at a specified fin pitch, and slits are formed on each plate-shaped heat transfer fin, and in which air is supplied orthogonally to said heat transfer coils, characterized by a configuration in which ***a spacing between slits formed on the heat transfer fins is set within a range of 0.18 - 0.5 times the diameter of the heat transfer coils***, wherein two slits formed in front of the heat transfer coil and two slits formed behind said heat transfer coil ***are arranged so there is a mutually different length in a direction perpendicular to the air flow***, and wherein ***a cut profile between the two slits in different lengths is parallel to the air flow***.

(*Emphasis added*) Also, independent claim 4 recites:

> 4. (Once Amended) A heat exchanger in which heat transfer coils penetrate through a row of multiple plate-shaped heat transfer fins set at a specified fin pitch, and slits are formed on each plate-shaped heat transfer fin, and in which air is supplied orthogonally to said heat transfer coils, characterized by a configuration in which ***a width of each slit formed on each heat transfer fin is set within a range of 0.17 - 0.29 times a diameter of the heat transfer coils, and the spacing between slits formed on the heat transfer fins is set within a range of 0.18 - 0.5 times the diameter of the heat transfer coils***, wherein two slits formed in front of the heat transfer coil and two slits formed behind said heat transfer coil ***are arranged so there is a mutually different length*** in a direction perpendicular to the air flow, and wherein a ***cut profile between the two slits in different lengths is parallel to the air flow***.

(*Emphasis added*) Also, independent claim 5 recites:

> 5. (Once Amended) A heat exchanger in which heat transfer coils penetrate through a row of multiple plate-shaped heat transfer fins set at a specified fin pitch and in which air is supplied orthogonally to said heat transfer coils, characterized by a configuration such that within a plurality of slit arrays formed on a heat transfer fin, ***for a given slit array a slit formed on either edge of a heat transfer fin is partitioned into slits of different length***, and ***a position at which the slit is partitioned is staggered on each of the two edges of the heat transfer fin***, wherein ***a cut profile at the partitioned position between the two slits in different lengths is parallel to the air flow***.

(*Emphasis added*) Applicants respectfully submit that claimed features emphasized above are lacked in the prior art.

Claims 2-4 are rejected under 35 U.S.C. 102(b) as being anticipated by Yu. The Examiner states that Figs. 1 and 4 teach heat transfer coils penetrate through a row of multiple plate shaped fins that air is supplied orthogonally to the coils, Fig. 6 states slits are formed on the fins, and Fig. 9 shows the geometrical relationship between the slit width, spacing between slits etc. The Examiner states, from Fig. 9, the width of the slit are about the same as the spacing between two slits and both of them are approximately 0.25 times the diameter of the heater tube.

Applicants respectfully disagree these interpretations for at least reasons set forth as following.

First, according to the Yu's reference, especially referring to Fig. 6, the heat exchanger consists of several fins, each of which comprises strips (11a, 11b), (13a, 13b), 20, (14a, 14b), and (12a, 12b) arranged around the pipes 2. As shown, Yu proposes a configuration that those strips are arranged in an X-shape. For achieving a high heat exchanging efficiency, each pair of strips (11a, 11b), (13a, 13b), and (14a, 14b) and *formed opposite with respect to the fin plane 30.* Taking the pair of strips 11a and 11b as an example, *the two strips 11a and 11b are vertical symmetric to each other. Namely, strip 11a and strip 11b has the same geometric profile* (col. 3, lines 55-57). Also, all the other strip pairs have the same characteristics (col. 3, lines 51-67, col. 4, lines 1-14). The configuration of the strips arranged above intends to cause the air current to become turbulent when the air currents pass by the fin 1 in front of the pipes 2 (col. 3, lines 57-59). *Therefore, the strips of (11a, 11b), (13a, 13b), and (14a, 14b) respectively are substantially the same in the length.*

In contrast, according to claims 2-4 of the invention, the lengths of the front slits (such as 51, 52) are different, and the lengths of the slits behind the heat transfer coil (such as 55, 56) are different. *Partitioned slits 51 and 52 formed in front of the heat transfer coil 4 and slits 55 and 56 formed behind said heat transfer coil are arranged so there is a mutually different length among adjoining partitioned slits in the vertical direction,* as well as a mutually different length between directly opposite partitioned slits in the horizontal direction. As a result, it was discovered that the heat transfer efficiency of a heat exchanger could be increased by using the heat transfer fins of the present invention, in which the position at which slits are partitioned in different length.

Therefore, it is very clear that Yu fails to disclose, teach or suggest that *Partitioned slits (such as 51 and 52) formed in front of the heat transfer coil (4) and slits (such as 55 and 56) formed behind said heat transfer coil are arranged so there is a mutually different length among adjoining partitioned slits in the vertical direction.* Namely, features claimed in claims 2-4 are different from the Yu's disclosure.

Furthermore, referring to Yu's Fig. 6 again, the cut positions for each strip pair that perpendicular to the air current are inclined. Namely, *the cut position is not parallel to the direction of the air currents for each strip 11a, 11b, 13a, 13b, 14a, and 14b.*

In contrast, according to the invention, as shown in Fig. 1, the Partitioned slits 51 and 52 formed in front of the heat transfer coil 4 and slits 55 and 56 formed behind said heat transfer coil are arranged so there is a mutually different length in the vertical direction with respect to the air intake direction. *At the partitioned positions for each slits of slit pairs (51, 52) and (55, 56), their cut profile is parallel to the direction of the air intake.* Therefore, Applicants

respectfully submit that Yu clearly fails to disclose, suggest or teach such a feature claimed in claims 2-4. The invention clearly distinguishes over Yu.

In addition, in regard to the statement of Office Action, it stated that:

> *"Based on the geometric relationship within the figure 9, the width of the slit are about the same as the spacing between two slits and both of them are approximately 0.25 times the diameter of the heat transfer tube (Emphasis added)"*

In response, Applicants cannot accept such a hindsight rejection. Throughout the Yu's disclosure, nothing about the geometric relationship has been clearly defined (cols. 1~6). Yu's main point is concerning about the X-shape strip configuration. It is improper that a measurement is made and determined to anticipate the claimed invention after read on the numerical range defined in claims of the invention. The drawings of Yu's patent are only schematic ones. Namely, Yu fails to definitely disclose the claimed range as recited in claims 2-4 of the invention. In addition, the drawings are just schematically shown and cannot provide a proof that "both of them are approximately 0.25 times the diameter of the heater tube" as stated in the Office Action.

In the claimed invention, Applicants respectfully submit that all ranges and numerical data are supported by the specification and not disclosed, suggested or taught by Yu. Therefore, claims 2-4 of the invention disclose a distinguishable ranges over the Yu prior art.

For at least the reasons set out above, Applicants respectfully submit that Yu fails to disclose, suggest or teach every claimed subject feature as claimed in the invention, and claimds 2-4 patently define over Yu. Applicants respectfully render that the rejection under 35 U.S.C 102 is improper and should be withdrawn.

Claim 5 is rejected under 35 U.S.C. 102(b) as being anticipated by Aoyagi. The Examiner states that Figs. 1 teaches heat transfer coils penetrate through a row of multiple plate shaped fins that air is supplied orthogonally to the coils, Fig. 5 states slits are formed on the fins, and the slits (31, 32) are in different length on one edge of the fin and the slits (31, 32) are in staggered relationship with slits (35) on the other edge of the fin. In response, Applicants respectfully disagree these interpretations for at least reasons set forth as following.

Aoyagi also discloses a heat exchanger. However, referring to Fig. 9, *the rising portions of the cutouts between two adjacent cutouts, for example 31,32,* ***have angles of inclination*** (col. 5, lines 60-65). In contrast, according to the invention, as shown in Fig. 1, the rising portions of the slits between two adjacent slits are not inclined. This feature is not described in the Aoyagi reference.

In addition, as shown in Fig. 1 of the invention the slits 51, 52 and slit 55, 56 are in different length. Namely, *Partitioned slits 51 and 52 formed in front of the heat transfer coil 4 and slits 55 and 56 formed behind said heat transfer coil are arranged so there is a mutually different length among adjoining partitioned slits in the vertical direction.*

However, according to Aoyagi, only one edge side has cutouts in different length. Namely, cutouts 35 have the same length, but cutouts 31, 32, 33 may be in different length. This structure is different from our invention (col. 5).

For at least the reasons set out above, Applicants respectfully submit that Aoyagi fails to disclose, suggest or teach every claimed subject feature as claimed in the invention, and claim 5 patently defines over Aoyagi. Applicants respectfully render that the rejection under 35 U.S.C 102 is improper and should be withdrawn.

For at least the foregoing reasons, Applicants respectfully submit that independent claims 1-5 patently define over the prior art, and should be allowed.

The prior art made of record, but not relied upon, is not deemed to affect the patentability of the presently claimed invention.

CONCLUSION

For at least the foregoing reasons, it is believe that all pending claims 1-5 are in proper condition for allowance. If the Examiner believes that a conference would be of value in expediting the prosecution of this application, he is hereby invited to telephone the undersigned counsel to arrange for such a conference.

Respectfully submitted,
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ANNOTATED VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification

On page 5, after line 5, the following text is inserted.

Figure 5 shows the slit arrangement of the present invention before the slit is partitioned.

The paragraph beginning at page 5, line 17, has been replaced with the following rewritten paragraph:

Partitioned slits 51 and 52 formed in front of the heat transfer coil 4 and slits 55 and 56 formed behind said heat transfer coil are arranged so there is a mutually different length among adjoining partitioned slits in the vertical direction, as well as a mutually different length between directly opposite partitioned slits in the horizontal direction. As a result, the position at which the slits are partitioned is staggered. However, slits 53 and 54 formed side by side between heat transfer coil 4 and heat transfer coil 4 are of the same length. In Fig. 5, the partition positions 5, 6 are represented by dash lines. Namely, slits 51, 52 and slits 55, 56 are partitioned from one slit at positions 5, and 6 respectively.

In The Claim

Claims 1-5 have been amended as follows:

1. (Once Amended) A heat exchanger in which heat transfer coils penetrate through a row of multiple plate-shaped heat transfer fins set at a specified fin pitch and in which air is supplied orthogonally to said heat transfer coils, characterized by a configuration so as to satisfy the correlation expressed by the following numerical formula:

$Ws \geq (1\text{-}0.1\ (6\text{-}N)) \times W_F/(2N+1)$

where, Ws = width of each slit formed on said heat transfer fins, W_F = width of a heat transfer fin, and N = the number of slit arrays formed on said heat transfer fin / number of heat transfer fin units.

2. (Once Amended) A heat exchanger in which heat transfer coils penetrate through a row of multiple plate-shaped heat transfer fins set at a specified fin pitch, and slits are formed on each plate-shaped heat transfer fin, and in which air is supplied orthogonally to said heat transfer coils, characterized by a configuration in which [the] a width of each slit formed orthogonal to the air flow on each heat transfer fin is set within a range of 0.17 - 0.29 times [the] a diameter of the heat transfer coils, wherein two slits formed in front of the heat transfer coil and two slits formed behind said heat transfer coil are arranged so there is a mutually different length in a direction perpendicular to the air flow, and wherein a cut profile between the two slits in different lengths is parallel to the air flow.

3. (Once Amended) A heat exchanger in which heat transfer coils penetrate through a row of multiple plate-shaped heat transfer fins set at a specified fin pitch, and slits are formed on each plate-shaped heat transfer fin, and in which air is supplied orthogonally to said heat transfer coils, characterized by a configuration in which [the] a spacing between slits formed on the heat transfer fins is set within a range of 0.18 - 0.5 times the diameter of the heat transfer coils, wherein two slits formed in front of the heat transfer coil and two slits formed behind said heat transfer coil are arranged so there is a mutually different length in a direction perpendicular to the

air flow, and wherein a cut profile between the two slits in different lengths is parallel to the air flow.

4. (Once Amended) A heat exchanger in which heat transfer coils penetrate through a row of multiple plate-shaped heat transfer fins set at a specified fin pitch, and slits are formed on each plate-shaped heat transfer fin, and in which air is supplied orthogonally to said heat transfer coils, characterized by a configuration in which [the] a width of each slit formed on each heat transfer fin is set within a range of 0.17 - 0.29 times [the] a diameter of the heat transfer coils, and the spacing between slits formed on the heat transfer fins is set within a range of 0.18 - 0.5 times the diameter of the heat transfer coils, wherein two slits formed in front of the heat transfer coil and two slits formed behind said heat transfer coil are arranged so there is a mutually different length in a direction perpendicular to the air flow, and wherein a cut profile between the two slits in different lengths is parallel to the air flow.

5. (Once Amended) A heat exchanger in which heat transfer coils penetrate through a row of multiple plate-shaped heat transfer fins set at a specified fin pitch and in which air is supplied orthogonally to said heat transfer coils, characterized by a configuration such that within [the plural number] a plurality of slit arrays formed on a heat transfer fin, for a given slit array [the] a slit formed on either edge of a heat transfer fin is partitioned into slits of different length, and [the] a position at which the slit is partitioned is staggered on each of the two edges of the heat transfer fin, wherein a cut profile at the partitioned position between the two slits in different lengths is parallel to the air flow.

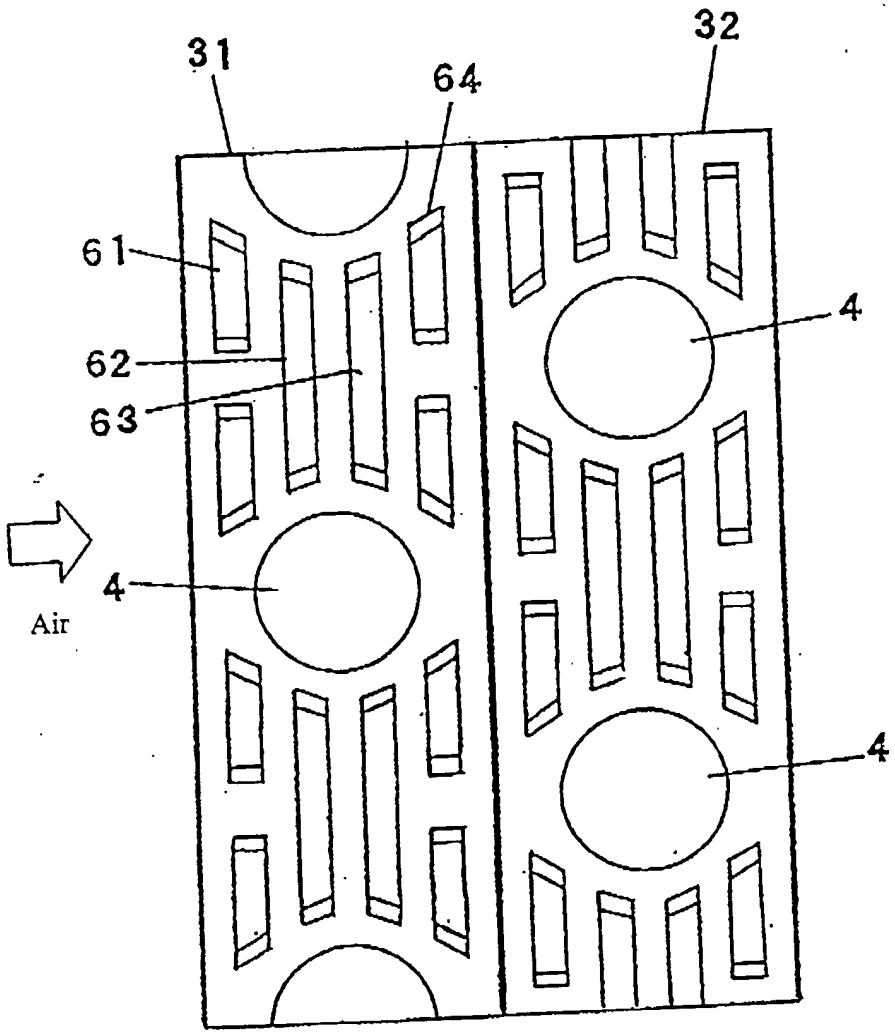
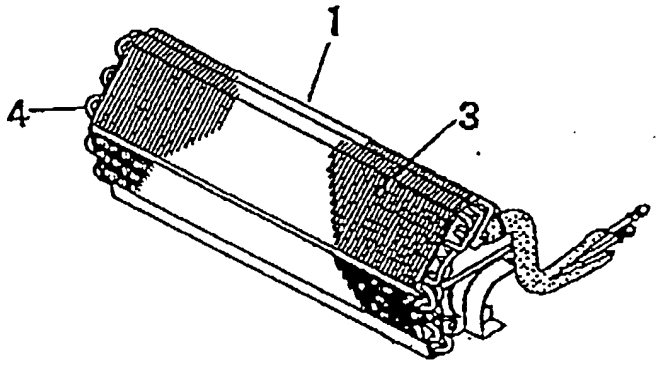


FIG. 3 (PRIOR ART)



~~(A)~~ FIG. 4A (PRIOR ART)

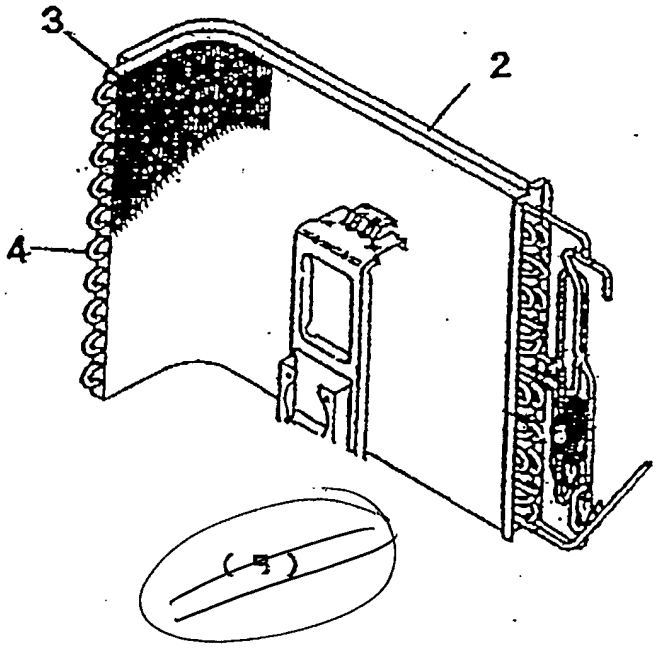


FIG. 4B (PRIOR ART)